Alignment Constraints in Optimality Theory: Two Examples

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1. Introduction

1.1. Alignment and Optimality Theory

This paper looks at the linguistic phenomenon of alignment, in which languages show a preference for certain linguistic features to be aligned with other linguistic features. The goal of this paper is to present to the reader a basic overview of how alignment works within languages by exploring examples from various languages. The framework by which alignment is explained is optimality theory, for which a brief explanation will also be given. This paper serves mainly as a summary of existing literature for readers who are not familiar with alignment in particular or optimality theory in general.

2. What is Alignment?

2.1. Overview

Alignment describes the tendency in languages for certain linguistic features to coincide, such as the location of primary word stress at the beginning of a word, or a question marker (such as -*ka* in Japanese) at the end of a word. As a constraint in Optimality Theory, it was initially proposed by Prince and Smolensky (1993/2004) to explain infixation(1) and further developed by McCarthy and Prince (1993). To illustrate, let's look at two examples, one involving the placement of stress in Garawa and Polish, and the other dealing with adaptation of foreign words in Japanese.

2.2. Word Stress in Garawa and Polish

In languages where word stress is predictable, the position of stress is often due to alignment constraints. McCarthy and Prince (1993) provide the following example from the Australian Aboriginal language Garawa. (The symbol σ represents a syllable, 'σ indicates a stressed syllable, and parentheses represent a parsed *foot* (a pair of syllables). Primary stress is in bold.).

(1) Stress patterns in Garawa

('**σσ**)	'**ya**.mi	"eye"
('**σσ**)σ	'**pun**.ja.la	"white"
('**σσ**)('σσ)	'**wat**.jim.'pa.nu	"armpit"
('**σσ**)σ('σσ)	'**ka**.ma.la.'rin.ji	"wrist"
('**σσ**)('σσ)('σσ)	'**ya**.ka.'la.ka.'lam.pa	"loose"
('**σσ**)σ('σσ)('σσ)	'**nan**.ki.ri.'ki.rim.'pa.yi	"fought with boomerang"

In metrical phonology, a word is divided into syllables, and two syllables join to make a "foot," represented above by parentheses. The foot that contains primary stress is known as the "head foot." Depending on the language, either the right or left syllable within a foot receives stress. In Garawa, primary stress always falls on the first syllable, or the left syllable in the first foot. Secondary stress is a little more complicated. While the head foot is aligned with the left edge of the word, all other feet are aligned with the right-edge of the word. Within each foot, the left syllable receives stress. Consequently, for words with an even number of syllables, the stress pattern is simple: every other syllable receives stress. For words with an odd number of syllables, there will always be two unstressed syllables immediately following the primary stress, after which the alternating stressed-unstressed pattern will begin.

Now compare Garawa with Polish (examples taken from and Rubach 1985 and Jacobs 2003):

(2) Stress Patterns in Polish

(’**σσ**)	’**row**.nik	“equator”
σ(’**σσ**)	zmec.’**zo**.na	“tired” (feminine)
(’σσ)(’**σσ**)	’te.le.’**wi**.zor	“television”
(’σσ)σ(’**σσ**)	’za.do.wo.’**lo**.ny	“happy, satisfied” (masculine)
(’σσ)(’σσ)(’**σσ**)	’ka.na.’dyjs.ko.’**pol**.ski	“Canadian-Polish”
(’σσ)(’σσ)σ(’**σσ**)	’re.wol.’uc.jo.nis.’**ta**.mi	“revolutionary”

The parsing of feet in Polish, like that of Garawa, is aligned with both the beginning and the end of the word. A look at words with an odd number of syllables shows us that the stress pattern in Polish is actually a mirror-image of that of Garawa, with two unstressed syllables immediately *preceding* the primary stress. In section 4, it will be shown how Optimality Theory can neatly explain the variations in stress patterns between these two languages.

2.3. English Loan Words in Japanese

In this section, we will take a look at an interesting phenomenon in Japanese involving alignment and syllable structure. Japanese syllables can have the structure V, CV, VV, CVV, CVN, or CVQ where C stands for consonant, V for vowel, and N for a moraic nasal(2). In the structure

CVQ, the Q stands for the first half of a geminate, the second half representing the onset of the following syllable. Examples of each syllable type are given in (3) below.

(3) Japanese syllable structure

V	e	"picture"
CV	ka	"mosquito"
VV	ai	"love"
CVV	hai	"lungs"
CVN	san	"three"
CVQ.CV	hap.pa	"a leaf"

Of note is the fact that codas are not allowed in the Japanese syllable, with the exceptions being when the coda is a moraic nasal or the first part of a geminate. What happens, then, when a foreign word containing a coda is borrowed into Japanese?(3) Word-medially, we see the epenthesis of a vowel and the borrowed coda is represented as an onset, as below.

(4) Borrowed codas, word-medially.

Foreign word	**Japanese rendering**
pygmy (pI*g*.mi:)	pi.*gu*.mi:
Latvia (la*t*.vi.a)	ra.*to*.bi.a
rhapsody (ra*p*.so.di:)	ra.*pu*.so.di:

However, when the coda appears *word-finally*, a geminate is formed, as in (5) below.

(5) Borrowed codas, word-finally

Foreign word	**Japanese rendering**
clinic (klI.nI*k*)	ku.ri.ni*k.ku*
rap (ra*p*)	ra*p.pu*
bat (ba*t*)	ba*t.to*

As a geminate is both a coda of one syllable and an onset of the next, it appears that in Japanese, preserving the codas in loanwords is important *only when the coda occurs at the end of a word*.(4) In section 4, we will use Optimality Theory to examine how the various syllable constraints in Japanese interact to create this phenomenon.

3. An Introduction to Optimality Theory

3.1. The Basics

Optimality Theory (Prince and Smolensky 1993/2004) is a theory based on the ideas that a) there exists a set of (universal) constraints on the well-formedness of structures, b) these constraints can be minimally violated, and c) these constraints are ranked, so that lower-ranking constraints may be violated to satisfy higher-ranking constraints. The ranking of constraints is language-particular, so that a high-ranking constraint in one language may be a low-ranking constraint in another.

For a given input, the grammar selects the optimal structure from a large group of candidates. A function GEN is responsible for generating the candidates, while a function EVAL evaluates each candidate and selects the most optimal one. This process is represented using a constraint tableau, as in (6) below. Here, Candidate 1 is the optimal candidate because it satisfies the higher-ranking CONSTRAINT X, although it violates the lower-ranked CONSTRAINT Y. The optimal candidate is shown by using an arrow. Violations of constraints are represented by asterisks, and a fatal violation is represented by an asterisk followed by an explanation mark.

(6) Constraint Tableau, CONSTRAINT X ≫ CONSTRAINT Y

Input: /A/	CONSTRAINT X	CONSTRAINT Y
a. → Candidate 1		*
b. Candidate 2	* !	

Since CONSTRAINT X is more highly ranked than CONSTRAINT Y, we say that CONSTRAINT X *dominates* CONSTRAINT Y, which is usually written using the notation *CONSTRAINT X ≫ CONSTRAINT Y*. It is important to note that a winning candidate may (and usually does) violate one or more constraints, as Candidate 1 violates CONSTRAINT Y above. It is still the most optimal candidate because the other candidates have all violated higher-ranked constraints. Also, note that a re-ordering of the constraints may result in a different candidate becoming the most optimal. As an example, see how Candidate 2 becomes the optimal candidate when the order of CONSTRAINT X and CONSTRAINT Y is reversed, as we see below.

(7) Constraint Tableau, CONSTRAINT Y ≫ CONSTRAINT X

Input: /A/	CONSTRAINT Y	CONSTRAINT X
a. Candidate 1	* !	
b. → Candidate 2		*

3.2. Types of Constraints

Prince and Smolensky (1993/2004) argued that, generally speaking, languages have two types of constraints: *faithfulness constraints* and *markedness constraints*. Faithfulness constraints act to preserve the input.

There are two basic types: MAX-type constraints (for *maximize the input*) are violated whenever input material is deleted. DEP-type constraints (standing for *depend on the input for all material*) are violated whenever epenthetic material is added to the input.

Markedness constraints, on the other hand, are rules about structure. These include constraints against difficult to pronounce segments, such as consonant clusters, as well as alignment constraints, as we shall see later. The ordering of various faithfulness and markedness constraints produces the great variety of human languages.

To illustrate how these constraints work, consider a hypothetical language in which codas do not appear, but an epenthetic vowel, [a], does appear. From this information, we can conclude that there is a markedness constraint preventing codas, and that this constraint is ranked higher than the faithfulness constraint DEP. The constraint tableau is shown in table (11) below. The markedness constraint is called NO-CODA. The faithfulness constraints are MAX and DEP. These are defined below (adapted from definitions by Kager 1999):

(8) NO-CODA: Syllables are open.

(9) MAX: Every element in the input has a correspondent in the output.

(10) DEP: Every element in the output has a correspondent in the input.

The input is a hypothetical suffix /ik/ attaching to a hypothetical root /tela/.

(11) Faithfulness and Markedness Constraints NO-CODA, MAX ≫ DEP

Input: /ik+tela/	NO-CODA	MAX	DEP
a. → ikatela			*
b. iktela	*!		
c. ikela		*!	
d. itela		*!	

Note that the result is the same regardless of the ranking of NO-CODA and MAX, so we cannot tell from this data alone what their ranking is with regard to each other. This is represented by the dotted line in the tableau. However both NO-CODA and MAX must dominate DEP in order to get the optimal candidate [ikatela]. This is represented by the solid line in the tableau.

Finally, a candidate may be the most optimal candidate if it violates a constraint to a lesser degree than other candidates. Consider the hypothetical data once again, with a new candidate [ikaatela]:

(12) Multiple Violations NO-CODA, MAX ≫ DEP

Input: /ik+tela/	NO-CODA	MAX	DEP
a. → ikatela			*
b. iktela	*!		
c. ikela		*!	
d. itela		*!	
e. ikaatela			**!

Although both candidate (12a) and (12e) above violate the constraint DEP, (12e) violates it more than (12a) because of the additional vowel, and therefore is not considered optimal.

4. Using Optimality Theory to explain Alignment

4.1. Two examples

Section 4.2 illustrates how alignment constraints explain the word stress patterns in Garawa and Polish, and is largely adapted from McCarthy and Prince (1993) and Kager (2001). Section 4.3 illustrates how alignment constraints can explain phenomena in Japanese loanword phonology, and is based mostly on my own research, although similarities are found in Shinohara (2004).

4.2. Examples of word stress

Let us reexamine the data from 2.2 on stress patterns in Garawa and Polish. The table below shows the stress patterns of the two languages side by side.

(13) = (1) and (2) combined

Number of Syllables	**Garawa**	**Polish**
2	('$\boldsymbol{\sigma\sigma}$)	('$\boldsymbol{\sigma\sigma}$)
3	('$\boldsymbol{\sigma\sigma}$)$\sigma$	σ('$\boldsymbol{\sigma\sigma}$)
4	('$\boldsymbol{\sigma\sigma}$)('$\sigma\sigma$)	('$\sigma\sigma$)('$\boldsymbol{\sigma\sigma}$)
5	('$\boldsymbol{\sigma\sigma}$)$\sigma$('$\sigma\sigma$)	('$\sigma\sigma$)σ('$\boldsymbol{\sigma\sigma}$)
6	('$\boldsymbol{\sigma\sigma}$)('$\sigma\sigma$)('$\sigma\sigma$)	('$\sigma\sigma$)('$\sigma\sigma$)('$\boldsymbol{\sigma\sigma}$)
7	('$\boldsymbol{\sigma\sigma}$)$\sigma$('$\sigma\sigma$)('$\sigma\sigma$)	('$\sigma\sigma$)('$\sigma\sigma$)σ('$\boldsymbol{\sigma\sigma}$)

4.2.1. Alignment constraints

This section will show how these parsing come about by a different ranking of markedness constraints. First, there are the constraints which require the head foot to align with the left-edge or right-edge of the word. These are ALIGN-LEFT (WORD, HEAD FOOT) and ALIGN-RIGHT (WORD,

HEAD FOOT).

(14) ALIGN-LEFT (WORD, HEAD FOOT): The left-edge of the word must match the left edge of the head foot.

(15) ALIGN-RIGHT (WORD, HEAD FOOT): The right edge of the word must match the right edge of the head foot.

These constraints come into play when examining three-syllable words (head foot is in bold)[5]:

(16) Three-syllable words in Garawa. ALIGN-L(HD)≫ ALIGN-R(HD)

Input: /σσσ/	ALIGN-L(HD)	ALIGN-R(HD)
a. →(’**σσ**)σ		*
b. σ(’**σσ**)	*!	

(17) Three-syllable words in Polish ALIGN-R(HD)≫ ALIGN-L(HD)

Input: /σσσ/	ALIGN-R(HD)	ALIGN-L(HD)
a. →σ(’**σσ**)		*
b. (’**σσ**)σ	*!	

The above examples (16) and (17) above show that ALIGN-L(HD) dominates ALIGN-R(HD) in Garawa, and ALIGN-R(HD) dominates ALIGN-L(HD) in Polish.

Words with an even number of syllables will parse into an equal number of feet, with the left foot assigned as the head foot in Garawa and the right foot assigned as the head foot in Polish.

(18) Four-syllable words in Garawa. ALIGN-L(HD)≫ ALIGN-R(HD)

Input: /σσσσ/	ALIGN-L(HD)	ALIGN-R(HD)
a. →('**σσ**)('σσ)		*
b. ('σσ)('**σσ**)	*!	

(19) Four-syllable words in Polish ALIGN-R(HD) ≫ ALIGN-L(HD)

Input: /σσσσ/	ALIGN-R(HD)	ALIGN-L(HD)
a. →('σσ)('**σσ**)		*
b. ('**σσ**)('σσ)	*!	

Now, we will examine words having an odd number of syllables.

4.2.2. Lapse constraints

Words that contain an odd number of syllables cannot be parsed evenly, resulting in one syllable remaining unparsed. How do we know which syllables to parse and which one not to parse? A lapse constraint is needed to account for the pattern that we see. The word lapse here means "two consecutive unstressed syllables." This constraint was developed by Kager (2001), whose reasoning for the constraint stem from the fact that secondary stress feet are always aligned with the opposite edge of the primary stress foot (or head foot). In other words, the seven syllable pattern in Garawa, ('σσ)σ('σσ)('σσ), is common, but the seven syllable pattern ('σσ)('σσ)σ('σσ) has never been observed in the world's languages. Kager has proposed a series of lapse constraints, including a general constraint against lapses, called LAPSE, but for the two languages here, we need to utilize only the following constraint:

(20) LAPSE-AT-PEAK: A lapse must be adjacent to the peak.

"The peak" in the definition above refers to primary stress. See how this constraint works nicely for a seven syllable word in Garawa.

(21) Seven-syllable words in Garawa

Input: /σσσσσσσ/	ALIGN-L(HD)	ALIGN-R(HD)	LAPSE-AT-PEAK
a. σ('**σσ**)('σσ)('σσ)	*!	*	
b. →('**σσ**)σ('σσ)('σσ)		*	
c. ('**σσ**)('σσ)σ('σσ)		*	*!
d. ('**σσ**)('σσ)('σσ)σ		*	*!

For Polish, we need to include a more general version of the previously discussed alignments constraints. These constraints simply require the right- and left-edges of a word to correspond to the right- and left-edges of a foot.

(22) ALIGN-RIGHT (WORD, FOOT): The right edge of the word must match the right edge of a foot

(23) ALIGN-LEFT (WORD, FOOT): The left edge of the word must match the left edge of a foot

(24) Seven-syllable words in Polish

Input: /σσσσσσσ/	ALIGN-R (HD)	ALIGN-L (HD)	LAPSE-AT-PEAK	ALIGN-R	ALIGN-L
a. σ('σσ)('σσ)('**σσ**)		*			*!
b. ('σσ)σ('σσ)('**σσ**)		*	*!		
c. →('σσ)('σσ)σ('**σσ**)		*			
d. ('σσ)('σσ)('**σσ**)σ	*!	*	*		

Without the general ALIGN-L constraint, we would expect (24a) to be optimal, or at least as optimal as (24c), since the placement of the unparsed syllable at the left-edge of the word ensures that there is no lapse at all.[6]

4.2.3. Summary

General and specific alignment constraints account for the variations in stress patterns between Garawa and Polish. ALIGN-R(HD) is likely undominated in Polish (as well as ALIGN-L(HD) in Garawa), and as such will never be violated. In section 4.3.2, we will see an alignment constraint that is violated when a higher-ranked constraint needs to be satisfied.

4.3. Loan Words in Japanese

What kind of constraints explain what is happening in Japanese in the borrowing of foreign words? Loan word phonology in Japanese is quite complex, so for this paper, only the case of borrowed words with word-medial codas and word-final codas will be considered. Here are the two cases, presented again.

(25) = (4) Borrowed codas, word-medially.

Foreign word	**Japanese rendering**
pygmy (pI*g*.mi:)	pi.*gu*.mi:
Latvia (la*t*.vi.a)	ra.*to*.bi.a
rhapsody (ra*p*.so.di:)	ra.*pu*.so.di:

(26) = (5) Borrowed codas, word-finally

Foreign word	**Japanese rendering**
clinic (klI.nI*k*)	ku.ri.ni*k*.*ku*
rap (ra*p*)	ra*p*.*pu*
bat (ba*t*)	ba*t*.*to*

4.3.1. Constraints

To see how the foreign words are rendered in Japanese under an OT construction, four constraints will be considered. The constraints MAX and DEP from section 3.2 are repeated here.

(27) = (9) MAX: Every element in the input [7] has a correspondent in the output.

(28) = (10) DEP: Every element in the output has a correspondent in the input.

(29) CODACOND: A coda cannot license place features. (Ito & Mester 2002)

CODACOND (Coda Condition) restricts the content of a coda. As mentioned in section 2.3, the coda position is restricted in Japanese to nasals and geminates, both of which share their place features (or place of articulation) with the following onset.

(30) ALIGN-R (GRWD, σ): The right edge of a Grammatical Word coincides with the right edge of a syllable.

This alignment constraint requires a grammatical word, or stem, to align with the edge of syllable.

How do these constraints rank in Japanese? Clearly, MAX is ranked higher than DEP, as in all examples of borrowing we see epenthesis but no deletion of input segments. The English word *text*, for example, is rendered as [te.ki.su.to], for a total of three epenthetic segments, rather than deleting one of the sounds in the complex coda. To see how the other constraints rank, consider the rendering of the English word *bat* into

Japanese [bat.to].

(31) Word-final coda in loanword: MAX, CODACOND, ALIGN-R(σ)$\gg$ DEP

Input: /bat/	MAX	CODACOND	ALIGN-R(σ)	DEP
→ a. bat.to				**
b. bat		*!		
c. ba.to			*!	*
d. ba	*!			

From this table we can see that MAX, CODACOND, and ALIGN-R(σ) must dominate DEP. We still do not know how the three higher constraints rank with respect to each other.

Since, ALIGN-R(GRWD, σ) only refers to the right edge of the word, we should not see gemination word-medially.

(32) Word-medial coda in loanword: MAX, CODACOND, ALIGN-R(σ) $\gg$ DEP

Input: /pIg.mi:/	MAX	CODACOND	ALIGN-R(σ)	DEP
→ a. pi.gu.mi:				*
b. pig.gu.mi:				**!
c. pig.mi:		*!		

4.3.2. The case of superheavy syllables

There is an additional case we need to examine. When a loanword input contains a tense vowel or a diphthong followed by a consonant in the final syllable, there is no gemination in the output, as can be seen below.

(33) Word-final coda with tense vowel in loanword

Foreign word	**Japanese rendering**
pipe (/pai*p*/)	[pai*pu*]
gate (/gei*t*/)	[gee*to*]
grade (/grei*d*/)	[guree*do*]
beach (/bi:*tš*/)	[bi:*tši*]

Here we can see that our alignment constraint is being violated. There must be a higher-ranked constraint which rules out candidates like [paip.pu] and [gu.reed.do]. This is really the heart of Optimality Theory: that rules may be broken to satisfy other, more highly-ranked rules. In this case, the constraint seems to be a markedness constraint against "over-heavy syllables" containing both a long vowel and a consonant. At most, Japanese words can have only two moras in a syllable (Wenck 1966, Vance 1987).(8) Therefore, a gemination which results in a three-mora syllable (9) is ruled out. This could be as the result of a constraint against having more than two moras in a syllable, such as one proposed by Kager in his analysis of Icelandic:

(34) *3μ: No trimoraic syllables (Kager 1999).

Because the constraint MAX dominates ALIGN-R (GRWD, σ), gemination does not occur. If the order was reversed, we would see vowel shortening instead. As the table below shows, the ranking of *3μ and MAX above ALIGN-R (GRWD, σ) gives us the expected result.

(35) Word-final coda with tense vowel in loanword: *3μ,MAX≫ ALIGN-R(σ)

Input: /paip/	*3μ	MAX	ALIGN-R (σ)
→pai.pu			*
paip.pu	*!		
pap.pu		*!	
pip.pu		*!	

Notice that the preferred candidate does not violate Max, only Align-R. The consonant segment /p/ is retained, but as an onset, not as a coda.

4.3.3. Summary

The constraint ALIGN-R(GRWD, σ) forces a coda in the input to become a coda in the output, resulting in gemination, but this will occur only at the right-edge of a the word. Gemination is abandoned when it leads to a superheavy (3μ) syllable.

5. Summary

In this paper, we have looked at alignment, as explained in terms of Optimality Theory. Specifically, we have examined its important role in placing stress, as well as its perhaps unexpected role in rendering foreign words into native ones. Their real usefulness may be that they direct the child who is learning language to pay attention to what is happening on the edges of words, making acquisition a little bit easier.

Notes

(1) an infix is a morphological element which differs from prefixes and suffixes in that attaches itself to a linguistic feature *inside* the word, not at the edge

(2) Generally speaking, a moraic nasal is a nasal that has the same *weight*

as a vowel. In other words, it is pronounced for the same duration as a vowel (each are 1 mora long). The word, *kantan* (easy), which contains two moraic nasals, is, including the two vowels, four moras long. This word would normally be pronounced twice as long as the similar word *kata* (shoulder), which contains just the two vowels, and therefore two moras. Moras are represented with the symbol μ.

(3) Note that if the coda in the foreign word is [n], it will be represented in the borrowing by the Japanese moraic nasal in coda position, whether it appears word-medially or word-finally. Words of this type will not be considered in this paper.

(4) Specifically, the right edge of the input. Although the end of the borrowed word is recognized as such, it does not become the end of the Japanese word due to the aforementioned constraints against codas.

(5) The literature also includes constraints such as PARSE-SYLL which requires each syllable to belong to a foot, and FT-BIN which requires feet to be binary. In both Garawa and Polish, FT-BIN dominate PARSE-SYLL, which leaves a single syllable unparsed in words with an odd number of syllables.

(6) As mentioned above, Kager (2001) postulates a general lapse constraint, simply called LAPSE, which prohibits any adjacent unstressed syllables. In Polish, this constraint would need to be dominated by the constraint ALIGN-L(WORD, FOOT).

(7) The input for word borrowings is a topic of debate in the literature (See Silverman 1992 and Paradis and LaCharite 1997 for contrasting ideas). For the purposes of this paper, I will consider the input to be the segmental spoken output of the borrowed word in its native language, although in the case of Japanese, it seems likely that the orthography of the borrowed word also plays a strong part.

(8) There are cases where there may be three moras between morpheme or word boundaries (ie. /toot.ta/ "*pass*-past tense marker"). Also, there are a few borrowed words that might have three moras: *roon* "loan" and *sain* "sign" are two examples. Vance (1987) states that these three-mora syllables are usually reduced to two moras in normal speech, ie. [lon], [too.ta]. I will not consider those examples here.

(9) In some languages, geminates or codas do not have weight; they would not add a mora to the syllable. Japanese, however, does not appear to be

such a language. See Shibatani (1990) for an analysis. A high-ranking constraint, such as WEIGHT-BY-POSITION (Kager 1997), would make sure that a geminate is always associated with a mora.

References

Jacobs, H. (2003). On the change from left to right word-edge main stress in Icelandic, Polish and Latin. *Nordic Journal of Linguistics*, 26, 259-282.

Kager, R. (1997) Rhythmic Vowel Deletion in Optimality Theory. In Roca, I. (ed.), *Derivations and Constraints in Phonology*. New York: Oxford University Press.

Kager, R. (1999). Optimality Theory. Cambridge University Press.

Kager, R. (2001). Rhythmic directionality by positional licensing. Handout of talk presented at Fifth HIL Phonology Conference (HILP 5), University of Potsdam. [Available on Rutgers Optimality Archive, ROA-514]

McCarthy, J.J. (2003). OT constraints are categorical. *Phonology* 20, 75-138.

McCarthy, J.J. (2008). *Doing Optimality Theory*. Blackwell Publishing.

McCarthy, J.J. and Prince, A. (1993) Generalized Alignment. In G. Booij & J. van Marle (Eds.) *Yearbook of Morphology* (pp 79-153). Dordrecht: Kluwer.

Paradis, C. & Lacharite, D. (1997). Preservation and minimality in loanword adaptation. *Journal of Linguistics* 33. 379-430

Prince, A. and Smolensky, P. (1993/2004) *Optimality Theory: Constraint Interaction in Generative Grammar*. Malden, MA& Oxford: Blackwell.

Rubach, J. (1985). A grid theory of stress in Polish. *Lingua*, 66, 281-320.

Shibatani, M. (1990). *The languages of Japan*. Cambridge: Cambridge University Press.

Shinohara, S. (2004). Emergence of Universal Grammar in foreign word adaptations. In R. Kager, J. Pater & W. Zonneveld (Eds.), *Constraints in Phonological Acquisition* (pp. 292-320). Cambridge: Cambridge University Press.

Silverman, D. (1992) Multiple scansions in loanword phonology: evidence from Cantonese. *Phonology* 9. 289-328.

Vance, T. J. (1987) *An Introduction to Japanese Phonology*. Albany: SUNY Press.

Wenck, G. (1966) *The Phonemics of Japanese: Questions and Attempts*. Wiesboden: Otto Harrassowitz.